

REMARKS/ARGUMENTS

Applicants respectfully request reconsideration and allowance in view of the following remarks. In the Office Action, mailed January 18, 2008, the Examiner rejected claims 1, 2, 4, 7-14, 16-20, 22-24, 26, 27, and 30. By this response, claims 1, 2, 4, 5, 8, 10, 14, 15, 16, 17, 20, 22, 23, 24, 26, 27, 29, 30, and 32 have been amended, and new claim 33 has been added. No new matter has been added, as explained in detail below. Following entry of this response, claims 1-33 will be pending in the application.

Claim Objections

In the office action, claims 4, 5, 15-17, 22, 23, 26, 29 and 32 have been objected to because of alleged informalities. Applicant has revised these claims, and for at least these reasons, requests withdrawal of the objections.

Claim Rejections – 35 USC § 112

In the office action, claims 2, 8, 10, and 26 are rejected under 35 USC § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter Applicant regards as the invention. Applicant has amended these claims.

In particular, claim 2 has been amended to recite that the act of obtaining a plurality of first overall gains includes: for each one of the plurality of transmitter units, the transmitter unit sending a test signal to the first receiver unit, and the first receiver unit receiving the test signal from the transmitter unit. No new matter is introduced by this amendment, support for which can be found e.g. in paragraph [0035]¹. This amendment clarifies which unit sends the test signal and which unit receives the test signal.

Claim 8 has been amended to recite that each element of the correction matrix is a ratio of a corresponding element of a first diagonal matrix and a corresponding element of a second diagonal matrix, that the first diagonal matrix has the gains of the plurality of receiver units as its elements, and that the second diagonal matrix has the gains of the plurality of transmitter units as

¹ [0035] "Similarly, a TX baseband signal $x_i \dots$ is applied to transmitter unit ... for antenna i and the RX baseband signal x_j from receiver unit ... is measured."

its elements.

Likewise, Claim 10 has been amended to recite that each element of the correction matrix is a ratio of a corresponding element of a first diagonal matrix and a corresponding element of a second diagonal matrix, and wherein the first diagonal matrix has the gains of the plurality of transmitter units as its elements, and the second diagonal matrix has the gains of the plurality of receiver units as its elements.

No new matter is introduced by the above amendments. Support can be found e.g. in paragraphs [0045], [0053], and equations 23 and 24, of the present application.

Applicant submits that the Examiner's question regarding how the elements of the correction matrix relate to the gains have been clarified, and the rejections under 35 USC 112 of Claims 8 and 10 have been overcome by the above amendments.

Regarding Claim 26 (which depends on claim 24, and was rejected under 35 USC 112, second paragraph), the Examiner stated that it is unclear what is meant by "based on two different pilots exchanged with the wireless entity." In response, claim 26 has been amended to clarify that the third calibration is performed using two different pilots transmitted by the first wireless entity to a second wireless entity, the second wireless entity configured to estimate the errors in the correction matrix based on the two different pilots, thus overcoming this rejection. Also, the preamble of claim 24 has been amended to recite a method of calibrating transmitter units and receiver units at a first wireless entity.

New claim 33, depending on claim 26, has been introduced, reciting that the first wireless entity and the second wireless entity is a user terminal or an access point. No new matter is introduced by these amendments, support for which can be found for example in paragraphs [0009] ("For follow-on calibration, one wireless entity (e.g., the access point) transmits two different pilots, and the other wireless entity (e.g., the user terminal) estimates the errors in the correction matrices for the access point and the user terminal based on the pilots..."), [0077]², and [0078]-[0082].

² [0077] "For clarity, a specific embodiment of the follow-on calibration is described below. ... the access point transmits a MIMO pilot on the downlink... and also transmits a steered reference [steered pilot] on the downlink."

Applicant submits that the Examiner's question regarding what is meant by "based on two different pilots exchanged with the wireless entity" has been clarified, and the rejection under 35 USC 112 of Claim 26 has been overcome by the above amendments.

Claim Rejections – 35 USC § 102

In the office action, claims 1, 4, 7, 9, 11, 14, 16, 17, 20, 22-24, 27 and 30 are rejected under 35 USC § 102, as allegedly being anticipated by Vaidyanathan et al. (U.S. Patent No. 7,031,669) ("Vaidyanathan"). Applicant traverses these rejections.

Vaidyanathan is different from the present application, which is directed to calibration of transmitter and receiver units in a MIMO system by determining the gains of these units based on overall gains obtained using baseband (single-frequency) signals, then deriving correction matrices based on these gains.³ Vaidyanathan discloses techniques (further described below) for correcting for phase and amplitude offsets in MIMO devices that are very different from those based on overall gains, as disclosed and claimed in the present application. Nowhere does Vaidyanathan teach or suggest calibration techniques that involve obtaining the overall gains of any transmitter and/or receiver units in MIMO systems based on baseband test signals as claimed in the amended claims.

Unlike in the present application, the Vaidyanathan amplitude (and phase) offsets or mismatches are determined by measuring phase and amplitude responses when supplying a signal to a transmitter in a first antenna path, then coupling the signal to a second antenna path where the signal is downconverted by an associated receiver. *See, e.g.*, Vaidyanathan Abstract lines third sentence; Col. 2, lines 3-12. Vaidyanathan discloses that phase and amplitude offset correction values are then computed from such phase and amplitude measurements. *See, e.g.*, Vaidyanathan Abstract, and Col. 2, lines 14-25. In other words, Vaidyanathan discloses calibration techniques that are entirely different from those disclosed and claimed in the present application. As further explained below, nowhere does Vaidyanathan teach or suggest

³ *See e.g.* Abstract ("... N first overall gains ... are obtained N second overall gains are also obtained. The gain of each ... unit are determined based on the first and second overall gains. At least one correction matrix is then derived based on the gains"); paragraphs [0007], [0033]-[0035] (describing how the overall gains are obtained) and [0038]-[0040] (describing how the gains of the units are determined based on the overall gains, and how the correction matrices are derived based on the gains).

computing first overall gains and second overall gains, where each first overall gain is proportional to a ratio of the signal level of a baseband (single frequency) signal received by one of the receiver units (the “first receiver unit”) to the signal level of the baseband signal sent by the associated transmitter, and each second overall gain is proportional to a ratio of the signal level of a baseband signal sent by one of the transmitter units (the “first transmitter unit”) to the signal received by the associated receiver unit, as required by the rejected claims (as currently amended).

Claims 1, 14, 20, 24, 27, and 30

Independent claims 1, 14, 20, 24, 27, and 30 have been amended to recite the above subject matter. Claims 1, 14 and 20 have been amended to recite that each first overall gain is proportional to a ratio of the signal level of a baseband signal sent by the associated transmitter unit to the first receiver unit, to the signal level of the baseband signal received by the first receiver unit from the associated transmitter unit, and that each second overall gain is proportional to a ratio of the signal level of a baseband signal received by the associated receiver unit from the first transmitter unit, to the signal level of the baseband signal sent by the first transmitter unit to the associated receiver unit. Likewise, claims 24, 27 and 30 have been amended to recite that the gain of each transmitter unit is proportional to a ratio of the signal level of one of the test signals sent by that transmitter unit and received by an associated receiver unit, and the gain of each receiver unit is proportional to a ratio of the signal level of one of the test signals received by that receiver unit and sent by an associated transmitter unit.

No new matter is added by these amendments, support for which can be found throughout the specification. *See, e.g.*, paragraph [0033] (“the overall gain [for a transmitter] $r_{11,t11}$ may be obtained as the negative of the ratio of the TX baseband signal level to the RX baseband signal level for antenna 1”), and equation (7). *See*, paragraphs [0034]-[0036], [0038], and [0040].

Vaidyanathan fails to teach or suggest anywhere subject matter recited in the amended rejected claims, as set forth above.

Item 9 of the Office Action states: “Vaidyanathan ... discloses ... a processor that measures a plurality of overall gains (see “ γ ”) and determines of each transmitter or receiver unit

(see “c1”)), and cites to Figures 3-7, Col. 1: 46-57, Col. 9:5 – Col. 10: 31; Col. 11:30 – Col. 12:48; and Col. 15:20-25. Applicant respectfully traverses. Nowhere does Vaidyanathan teach or suggest obtaining any overall gains as recited in the amended claims.

The symbol γ in Vaidyanathan does not relate to the overall gains as claimed in the amended claim. Rather, (as seen for example in Vaidyanathan Col. 5: 38 – Col. 6:5, and equations (2a) and (2b)), γ in Vaidyanathan are amplitude mismatches that are computed across a number of frequencies f_k , and more specifically from an average of the ratios of first and second measured amplitudes across the frequencies f_k ,⁴ and do not relate to any overall gains g_{ii} obtained from a single frequency baseband signal, as disclosed and claimed in Applicant’s application. Also, the coefficients γ in Vaidyanathan are the coefficients of a correction matrix computed to achieve the condition of channel symmetry (See, e.g., Col.5:45-49, and Col. 7:21-23 (“...correction values ... γ_i are computed in order to achieve the condition of equations (2a) or (2b)”). In short, the coefficients γ are different from, and computed in an entirely different manner from, the overall gains g_{ii} disclosed and claimed in the present application.

In summary, nowhere in Vaidyanathan is there any teaching or suggestion of obtaining overall gains, where each overall gain is proportional to the ratio of the transmitter (TX) baseband signal level to the receiver (RX) baseband signal level (or vice versa, for “second” overall gains), as disclosed and claimed in Applicant’s application. Nor is there any teaching or suggestion in Vaidyanathan of determining correction matrices for calibration, based on such overall gains. In Vaidyanathan the correction matrices are determined not by computing overall gains obtained from ratios of baseband signal levels, but by measuring phase and amplitude responses in a first antenna path, coupling the signal to a second antenna path where the signal is downconverted, then computing the correction values (including amplitude correction components γ) by averaging over a number of frequencies f_k and solving equations that imposed channel symmetry condition.

For at least these reasons, Vaidyanathan fails to teach or suggest the above discussed limitations of the rejected claims. Therefore, Vaidyanathan does not anticipate claims 1, 14, 20,

⁴ See Vaidyanathan Col. 9, lines 57-60 (“The amplitude mismatch γ_2 is estimated from an average of the ratios of the first and second measured amplitudes ... across the frequencies f_k .”)

24, 27, as currently amended, nor does Vaidyanathan anticipate claims 4, 7, 9, 11, 16, 17, and 22-23, which depend on respective ones of the independent claims 1, 14, and 20. Applicant respectfully requests withdrawal of these rejections.

Claim Rejections – 35 USC § 103

In the office action, claims 12, 13, 18 and 19 are rejected under 35 USC § 103 as allegedly being unpatentable over Vaidyanathan. Applicant traverses these rejections.

As discussed above with reference to independent claims 1, 14, 20, 24, 27, Vaidyanathan fails to teach or suggest at least the limitations set forth above of the amended claims, namely obtaining a plurality of first overall gains, each first overall gain proportional to a ratio of the signal level of a baseband signal sent to the first receiver unit by an associated transmitter unit, to the signal level of the baseband signal received by the first receiver unit from the associated transmitter unit, and a plurality of second overall gains, each second overall gain proportional to a ratio of the signal level of a baseband signal received from the first transmitter unit by an associated transmitter unit, to the signal level of the baseband signal sent by the first transmitter unit to the associated receiver unit. Nor does Vaidyanathan teach or suggest determining the gains of the transmitters based on the first overall gains and determining the gains of the receivers based on the second overall gains.

For at least these reasons, claims 12-13 (which depend on amended independent claim 1), and claims 18 and 19 (which depend on claim 14) are not rendered obvious under 35 USC § 103 by Vaidyanathan. Applicant respectfully requests withdrawal of these rejections.

Allowable Subject Matter

In the office action, claims 3, 5, 6, 15, 21, 25, 28, 29, 31 and 32 are objected to as allegedly being dependent upon a rejected base claim, but would be allowable if rewritten in independent form to include all of the limitations of their respective base claim and any intervening claims.

Applicant thanks the Examiner for correctly noting the allowability of this subject matter. However, for at least the reasons set forth above, the amended base claims are believed to be in condition for allowance. Therefore, these claims have not been rewritten in independent form.

CONCLUSION

Therefore, for at least the reasons presented above with respect to all of the pending claims subsequent to entry of this response, Applicants assert that all claims are patentably distinct from all of the art of record. All objections and rejections having been addressed, it is respectfully submitted that this application is in condition for allowance and a Notice to that effect is earnestly solicited. If any points remain in issue that the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

Charge Statement: For this application, the Commissioner is hereby authorized to charge any required fees or credit any overpayment to Deposit Account 17-0026.

Respectfully submitted,
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